“The most valuable thing you can make is a mistake – you can’t learn anything from being perfect.”

- *Adam Osborne*
(Innovator of first PC)

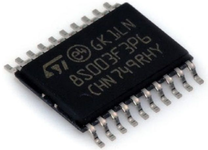
Agenda for today

- Quick Recap
- Understanding hardware
  - Microcontroller v/s microprocessors
  - What look for while choosing an MCU development board
  - Details of ESP8266 and Node-MCU
- Understanding software
  - Python and Micropython
  - IDEs for programming ESP devices
  - Using Wokwi - a hardware simulator
- Getting started with ESP8266 and Micropython using Wokwi
  - Blink an LED
- Daily challenge
- Prized challenges

Hardware

The brain of every device

Microcontrollers v/s Microprocessors



Microprocessors

1. Have all the required stuff (RAM, Storage, etc.) in a single chip

2. They are expensive

3. Meant for resource intensive tasks, like: Video playing, Internet browsing or anything that we do on our computers

Microcontrollers

1. Have all the required stuff (RAM, Storage, etc.) in a single chip

2. Very cheap in cost

3. Meant for the tasks where we don't need heavy resources, like; Running a washing machine, monitoring a Toaster, Automatics doors, switches,etc

SBCs v/s MCU Dev-boards

Single board computer (SBC)

1. This is based on microprocessors

2. Good for projects requiring heavy computing resources; like; setting up a server, IoT gateway, Running AI models, etc.

Microcontrollers Dev-boards

1. This is based on microcontroller

2. Good for projects requiring low computing resources; like; home automation, Industrial monitoring devices, etc.

What to look for in a MCU Dev board

- Processing power (Cores, Frequency)
- Onboard RAM and storage
- Special purpose memory (Like PSRAM if you want to process images and videos)
- Peripherals
  - No. of GPIOs - General purpose input output
  - No. of SerCOMs - Serial communication
  - USB support
  - OTG support
  - Display
  - Camera
  - Audio
  - ADC - Analog to Digital (ADC resolution - 8 Bit, 10Bit, 12 Bit, 24 Bit)
  - Etc.
- Onboard Wireless Connectivity - WiFi, Bluetooth
- Size of the board
- On board power supply, etc.

Some Popular MCU Dev boards

- Arduino (https://www.arduino.cc/en/hardware)
- ESP boards (https://www.espressif.com/en/products/devkits)
- RP2040 based boards (https://www.raspberrypi.com/products/rp2040/)
- And Many more…

ESP8266 (Microcontroller)

1. Tensilica L106 32-bit RISC processor, max clock speed of 160 MHz.

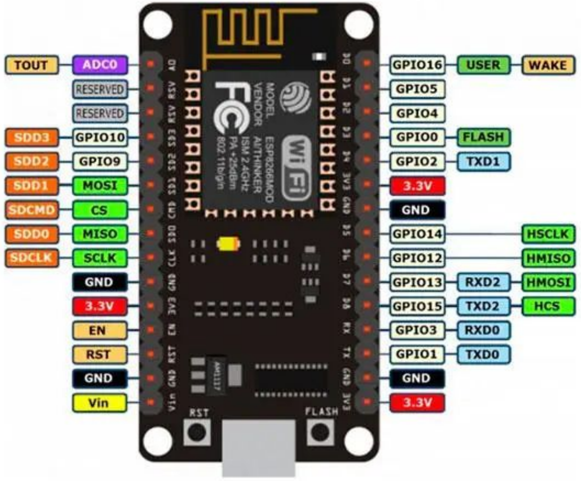
2. 50 kB RAM, 1 MB Flash Memory

3. 802.11 n support (2.4 GHz), up to 72.2 Mbps

4. Support Infrastructure BSS Station mode/SoftAP mode/Promiscuous mode

5. 17 GPIO pins

6. SPI, I2C, UART, I2S, PWM, IR Remote, 10 bit ADC



Software

The stuff that goes in brain

Why Python

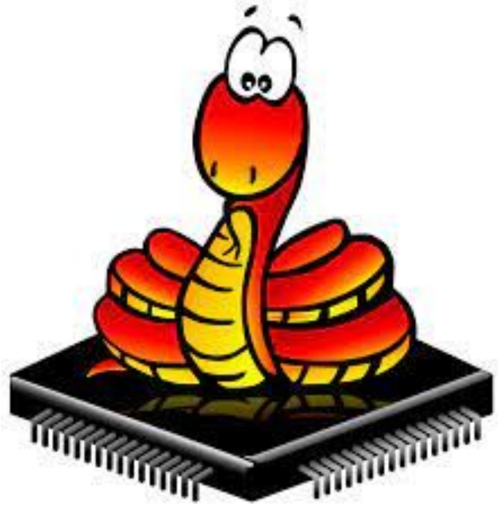
- Easy to learn
- Has an active, supportive community
- Hundreds of Python Libraries and Frameworks
- Big data, Machine Learning and Cloud Computing
- Flexible

Basics of Python Language

- Basic syntax
- Use of tabs
- Data Types
- Operators
- Conditionals (If- else)
- Loops (For - While)
- Try -except
- Functions
- Python inbuilt modules
  - JSON
  - time
  - …

Micropython

1. Program just like the standard Python
2. Packages to control various hardware peripherals
3. Supports many standard python packages
4. Can run on a resource constrained device
5. Easy to setup and get started



Getting started with Wokwi

- Good to get started with programming Microcontroller based development boards like; Arduino, raspberry pi pico, ESP8266/32, etc.
- Get feel of real hardware without even touching one
- Plenty of sensors, actuators, and other peripherals to try out different projects

WOKWi

www.wokwi.com

Write your first Micropython program

```
from machine import Pin


p0 = Pin(2, Pin.OUT)    # create output pin on GPIO0


while 1:
  p0.on()                 # set pin to "on" (high) level
```

Flashing uPython on ESP8266

micropython on esp8266

Daily Challenge

Problem Statement:

Write a program to interface RGB LED with ESP8266 and generate different colors.

Hints:

- Every pin on RGB LED will require a different GPI
- There is a function with name "value" in machine module that can be used for changing intensity of individual colors

Prized Challenge 1

Problem statement:

Build a device to control user interface of a windows system using different sensors with ESP8266

Constraints:

- The device should communicate wirelessly with the computer
- You can use any sensor of your choice. However, I recommend using 2 Ultrasonic sensors to implements various gestures.
- Use python for firmware as well as the software for controlling features on Windows

Resources required:

- Dev board and sensors
- Python modules
  - PyAutoGUI
  - Networking modules: urequests, pahomqtt, etc.

SAGE SUMMER SCHOOL

DataTurtles
Connect - Build - Inspire

Thank you

The SAGE GROUP

GROUP VENTURES

M/s Agrawal® Construction Co.
The SAGE Group

SIRT SAGE GROUP OF INSTITUTIONS
Engineering • Management • Pharmacy

SAGE INTERNATIONAL SCHOOL
Illuminating Minds Enriching Future Generations

SAGE UNIVERSITY INDORE

Apollo Sage HOSPITALS

APPL